SURVEY PROTOCOL FOR THE RED TREE VOLE

Arborimus longicaudus

(= *Phenacomys longicaudus* in the Record of Decision of the Northwest Forest Plan)]

Version 2.0

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EXECUTIVE SUMMARY

Species: Oregon red tree vole (*Arborimus longicaudus [= Phenacomys longicaudus* of the Record of Decision (ROD) of the Northwest Forest Plan (NFP])

Taxonomic Group: Mammal

Survey and Manage Component: Component 2, Survey before ground-disturbing activities

Objectives: The objective of this survey protocol is to provide a consistent approach for locating active red tree vole sites in proposed project areas within the species' known or suspected range and habitat conditions within the Northwest Forest Plan area. This version of the protocol (Version 2.0) replaces Interim Version 1.0 that was transmitted in 1996 as an attachment to U.S. Forest Service (R6) and Bureau of Land Management (BLM) memorandum (1736-PFP BLM-OR931/1950 FS; BLM Instruction Memorandum No. OR-97-009 dated November 4, 1996) on interim guidance for the red tree vole.

Range: The Oregon red tree vole is endemic to moist coniferous forests of western Oregon and extreme northwest California and its suspected range extends from the Columbia River south through western Oregon and the Siskiyou Mountains south to the Salmon and Klamath Rivers in northern California.

Habitat: Red tree voles are most frequently found in forests dominated by Douglas–fir (*Pseudotsuga menziesii*)that also may contain grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*) western hemlock (*Tsuga heterophylla*) and hardwoods. They are most numerous in late-successional and old-growth stands (Corn and Bury, 1986, Gillesberg and Carey, 1991) but may occur in younger forests with legacy characteristics of older stand structure.

Trigger for Protocol Surveys: If a project is located within the known or suspected geographic range of the red tree vole, and in a stand that is located at $\leq$ 6000 feet elevation, the following factors should be evaluated to determine whether pre-project surveys are needed:

The activity would modify the canopy structure of the stand or the crown of one or more individual trees. Prescribed fire is considered an activity that could potentially modify the canopy and/or affect individual animals due to smoke and heat.

AND

The project is in a stand that contains Douglas-fir averaging $\geq$ 16" dbh and the average stand canopy closure is $\geq$40%.

OR

The project is in a stand that contains Douglas-fir averaging $\geq$ 10" and $\leq$16" dbh and also contains any remnant Douglas-fir $\geq$ 21" dbh or greater than 120 years old, and the average stand canopy closure is $\geq$40%.

Projects affecting red tree voles or their nests are activities that remove or modify stand canopy structure or individual tree crowns and include activities that may isolate nest trees or alter the microclimate within the stand.

Threats: The major threats to this species are the continued loss of small isolated sites and the increased geographic isolation of remaining populations. This species has many life history characteristics that cumulatively raise concerns for its long-term persistence such as very small home ranges, low dispersal capability, extremely low reproduction potential, and a sensitivity to stand level disturbances

Information Needs: Current survey protocols and management guidelines could be improved with information on the species' reproductive potential, demographics, population status or trend, and the spatial extent of known sites. Generally, the scientific information needed for management cannot come solely from pre-project type surveys. To date pre-project surveys have been limited to locating new sites and collecting counts of the number of nest trees within projects. More studies are vital to improving our understanding of red tree vole ecology, range and distribution, habitat relationships, population trends and management options. Further genetic research is needed to resolve the geographic distribution of *Arborimus longicaudus* and *A.pomo* and to determine if there are any ecological differences between the two species.

NATURAL HISTORY

Introduction

The Oregon red tree vole (*Arborimus longicaudus)* is the most arboreal mammal in the Pacific Northwest (Carey 1996) and is endemic to moist coniferous forests of western Oregon and extreme northwest California. Its distribution is patchy and limited to coniferous forests west of the crest of the Cascade Mountains. Red tree voles depend on conifer tree canopies for nesting, foraging, travel routes, escape cover, and moisture (Carey 1991). Douglas-fir (*Pseudotsuga menziesii*) needles provide the primary food and building materials for nests. The vole is an important prey for the threatened northern spotted owl and other owls (Forsman et al. 1984). In southwestern Oregon the red tree vole may provide up to 50% of the items consumed by some pairs of spotted owls (Forsman et al. 1989).

Red tree voles were rated as highly vulnerable to local extirpations from habitat fragmentation or loss (Huff et al. 1992), and are recognized as closely associated with old-growth forest habitat (Carey 1989, Ruggiero et al. 1991). Significant declines in tree vole populations are expected from major reductions in old-growth Douglas-fir habitat (Huff et al. 1992).

Red tree vole nests tend to be clumped in their distribution on the landscape and may range from areas with 30 or more nests in a stand down to single isolated nest trees. Sites in old forest conditions have many nests and can cover several hundred acres. Isolated nests are generally found in low-quality habitat and are believed to be either a part of a declining residual site or associated with an individual attempting to disperse. Both types of sites are important to identify during pre-project surveys. Large sites will provide major support for tree vole population persistence, while sites with only one to a few nests may help maintain the species distribution and connectivity to higher-quality habitat throughout its geographic range.

Oregon red tree voles were added to Survey and Manage mitigation during the Northwest Forest Plan (NFP) Final Supplemental Environmental Impact Statement (FSEIS) (USDA, USDI 1994b) analysis because the species was believed to need more protection than provided by the standards and guidelines, Riparian Reserves, Late Successional Reserves (LSRs) and other land allocations of the NFP. The assumption was made that each LSR would likely support large populations of red tree voles, but because each of these populations may be isolated from others, connectivity of LSRs may be necessary to provide small breeding colonies between large reserves to facilitate gene flow from one reserve to another(USDA, USDI 1994c). Therefore stable, well-distributed tree vole populations depend to some extent on maintaining sites and habitat within Matrix land allocations.

Definitions

The following definitions are provided for the purposes of this protocol:

Unconfirmed Red Tree Vole Nest: Any arboreal nest that is not confirmed as belonging to a red tree vole or any other species.

Confirmed Red Tree Vole Nest: An arboreal nest that is confirmed as belonging to a red tree vole, and the activity status is undetermined.

Confirmed Active Red Tree Vole Nest: An arboreal nest that is confirmed as belonging to a red tree vole and is currently being used by a red tree vole.

Confirmed Inactive Red Tree Vole Nest: An arboreal nest that is confirmed as belonging to a red tree vole and determined not to be currently in use by a red tree vole.

Red Tree Vole Site: A red tree vole site is an individual nest tree or a collection of nest trees within a local area (all nest trees in a stand and adjacent stands that are not isolated from other clumps of nest trees by more that 100 m (330 ft).

Active Site: One or more confirmed active nests.
Inactive Site: All confirmed nests are not active.
Undetermined Site: Activity of nests is unknown.

Survey Area: An area that meets the trigger definition that is within the boundaries of the proposed ground-disturbing activity, which may be an area smaller than the project area.

Resin Duct: A structure found along the outer edge of a Douglas-fir needle that red tree voles split off and discard as feeding refuse before eating the remainder of the needle. These small, thread-like ducts accumulate in the nest and are used to line the nest chamber. A description of resin ducts as "mid-veins" is incorrect since the vascular bundle found in the middle of the needle is eaten, not discarded.

Taxonomic/Nomenclatural History

The red tree vole (*Arborimus longicaudus*) was described in 1890 from a specimen collected from Marshfield, Coos County, Oregon, and given the scientific name *Phenacomys longicaudus*. Johnson (1968) proposed elevation of the subgenus *Arborimus* to full generic rank and included the red tree vole and the white-footed vole (*A. albipes*) in this new genus. In 1991 Johnson and George (1991) split the sibling species, *Arborimus pomo*, from *A. longicaudus*. Their new species included all tree voles found along the California Coast and effectively split the red tree vole's range in half near the California-Oregon border. Subsequently, Murray (1995) presented DNA information suggesting specimens from south of the Smith River drainage in Del Norte County, California, were more similar to the Oregon tree voles than to other California populations.

Taxonomists still disagree on whether *Arborimus* should have full generic status, therefore even recent scientific publications vary as to which genus they list for the species. For example, Verts and Carraway (1998) use the genus *Phenacomys* while Carey (1999), Hayes (1996) and Maser (1998) all used *Arborimus*. Some recent DNA analysis (Murray 1995) supports *Arborimus* as an independent genus but these taxonomic issues are more academic and have no effect on the survey status of this species.

Geographic Range

The Oregon red tree vole is endemic to moist coniferous forests of western Oregon and extreme northwest California. Our understanding of the geographic range of the Oregon red tree vole has improved since the issuance of the NFP ROD. Medford District BLM and Pacific Northwest

Research Station conducted surveys and identified new vole sites in the Rogue, Applegate, and Illinois River Valleys that helped expand and delineate the eastern extent of the vole range in these dry forest communities. The most significant change in the species range since the NFP, however, is a clarification in the taxonomic relationship of populations in northern California.

In the original NFP Supplemental Environmental Impact Statement (SEIS) analysis, the agencies followed the range suggested by Johnson and George (1991) when they originally split the sibling species, *Arborimus pomo*, from the Oregon tree vole. They suggested there was a break in the distribution between the two species near the California - Oregon border. Murray (1995) subsequently presented DNA data suggesting specimens from adjacent to the Smith River drainage in Del Norte County, California, were more similar to Oregon tree voles than to other California populations. In addition, Maser (1998), based on his collecting in the Smith River drainage, also suggests populations from the Smith River are *A. longicaudus*.

This protocol was developed for surveys within the known and suspected range of the Oregon red tree vole, *Arborimus longicaudus*. The Survey and Manage requirements under the NFP do not apply to populations of *A. pomo* (NFP ROD UDSA USDI 1993).

This protocol includes significant changes in the range of the species. Areas of the federal forest lands in the eastern Rogue River Valley were removed, and portions of northwestern California were added. These changes are a result of information gained through four years of survey effort in the dry forests of southern Oregon, and a better understanding of the tree vole populations in northern California.

The known and suspected geographic range of *Arborimus longicaudus* extends from northern Oregon near the Columbia River south along the 6,000 foot elevation contour west of the crest of the Cascade Mountains to Prospect, Oregon. From Prospect, the eastern range line extends along the Rogue River to Medford, then south along Interstate 5 to the Siskiyou Mountain crest, then west along the crest to Condrey Mountain. The boundary then extends south from Condrey Mountain south along Buckhorn Creek to the Klamath River, and west along the Klamath River to the mouth of the Scott River. From the confluence of the Scott and Klamath Rivers, the range follows the boundary between the Happy Camp and Scott River Ranger Districts of the Klamath National Forest to the Marble Mountain Wilderness, then along the west side of the Marble Mountain Wilderness to the Salmon River. The line then follows the Salmon River to the Klamath River, and continues west along the Klamath River to the Pacific Ocean.

Removal of Areas in the Rogue River Valley. The eastern boundary of the range in southern Oregon was moved west to the Rogue River and Interstate 5. This new boundary is based on survey data provided by the Butte Falls and Ashland Resource Areas of Medford BLM. Extensive surveys conducted in forests east of this boundary did not identify red tree vole nests in any project areas.

Additions to the Range in Northern California. The following information was used to derive the new geographic range extensions in northern California.

- Specimens collected in northern California by Murray (1995) were from the Wilson Creek drainage, which is just southwest of the Smith River watershed----there are no barriers to dispersal from this area south to the Klamath River.
- Maser (1998) references collections in the Smith River drainage.

- Zentner (1977) identified active *Phenacomys longicaudus* nests in Siskiyou County, California in the vicinity of Happy Camp. These nests are geographically closer to *A. longicaudus* and are many miles east of the accepted range of *A. pomo.*
- The Siskiyou Crest to Condrey Mountain along Buckhorn Creek provides a logical geographic boundary to tie the eastern suspected range on the Ashland Resource Area of the BLM Medford District and Ashland Ranger District of the Rogue River National Forest with the suspected range in northern California that occurs north of the Klamath River.

The map in Figure 1 displays the known and suspected range of *Arborimus longicaudus* for the purpose of pre-project surveys conducted under this protocol.

Biology and Habitat Requirements

Biology. The red tree vole is a small microtine rodent with individual weight varying from about 25-50 grams (.87-1.75 ounces) (Hayes 1996). Total length (body and tail) for males ranges from 15.8-17.6 centimeters (6.2-6.9 inches) and females, from 17.0-18.7 centimeters (6.7-7.3 inches) (Hall 1981). The tail, which is relatively long, accounts for about 40 percent of the total length and is used for balance while moving along small branches.

The color of the dorsal pelage ranges from rust to cinnamon with some hairs tipped with black. Ventral pelage is whitish (Hall 1981). The well-haired tail is black to brown in color (Maser and Storm 1970; Whitaker 1988). Juveniles tend to be more brown in coloration with black tails (Maser and Storm 1970). Melanistic individuals have been observed (Hayes 1996).

Reproduction in this species is characterized by a long reproductive period, small litter size, and slow development of young (Carey 1991). Red tree voles can breed throughout the year, but generally litters are produced from February through September (Carey 1991). Litters range in size from one to four (Carey 1991) but average two (Howell 1926) and females can have several litters in a given
year. Gestation is approximately 28 days but may extend to 48 days if the female is lactating in support of an earlier litter (Carey 1991).

The young start to venture from the nest at about 4 weeks of age (Howell 1926). Activities of immature red tree voles (once they leave the maternal nest) are unknown. Red tree voles feed primarily on Douglas-fir needles, through they will occasionally feed on grand fir, white fir, Sitka spruce, and western hemlock needles (Carey 1991). Douglas-fir needles have resin ducts along each edge which the vole discards before eating the fleshy portions of the needles (Howell 1926; Whitaker 1988). The resin ducts are used for constructing nests (Howell 1926) and are a definitive indicator of tree vole use of a nest structure. Water is obtained from dew, rain, or condensation on foliage (Carey 1991).

The main predator on this species is probably the northern spotted owl, though other owl species, raccoons, marten, ringtail, and fishers prey upon them as well (Maser et al. 1981; Whitaker 1988).

Home Range/Dispersal. The species is nocturnal, and some individuals may spend the majority of their lives in the canopy, moving from tree to tree through the canopy (Carey, 1991). Though

they are almost exclusively arboreal, some terrestrial activity does occur; and occasionally individuals have been captured on the ground (Corn and Bury, 1986; Raphael, 1988). The individual home range size for this species is not well known. However, Biswell (in prep) found individual adult red tree voles that were radio-tracked for 35-106 days, used 2-7 (median=5) nests. The greatest straight-line distance between consecutively occupied nest trees was an overnight move of 75.8 m. (248.7 ft.). Mean distances moved between consecutive nest trees for males and females combined was 31.4 m. (SE=6.49) (112.8 ft). When moving to a new nest tree, adult voles re-occupied previously constructed nest structures at least 68 percent of the time. Thirty-six percent of 39 nest trees located via telemetry contained more than a single nest, and one tree contained 7 nests.

The greatest distance moved by a red tree vole was by a dispersing subadult male. Followed for 40 days, he was located in five different trees and reached a maximum straight-line distance from his natal nest tree of 340 m. (1115 ft.) (Biswell, in prep.). While moving greater distances than adults, subadults have extremely low survival rates. Red tree voles tracked using telemetry crossed small forest roads, small streams, and canopy gaps while traveling between nest trees.

Abundance. Since implementation of the NFP, in excess of 650 pre-project surveys have been conducted by Bureau Land Management and National Forest system biologists in western Oregon. These surveys have covered in excess of 85,932 acres and identified greater than 254 potential new red tree vole sites.

Vole abundance apparently varies by physiographic province, since some regions have far fewer sites than others. For example, the northern half of the Oregon Cascades including the Sandy, Clackamas, and North Santiam River basins have limited numbers of sites. In 1995 the Mt. Hood National Forest surveyed 38,611 acres including 62 % (26,976 acres) of all primary red tree vole habitat on the forest and confirmed 9 red tree vole nests (Mt. Hood National Forest, 1996). Primary habitat on the Mt. Hood included the most likely habitat conditions for finding red tree voles, and was defined as stands of large conifers (>21 dbh) located at less than 3,000 ft elevation within the western hemlock or pacific silver fir vegetation zones, and greater than 300 acres in size.

In contrast, 37,421 acres have been surveyed by the Medford District BLM accounting for approximately 44 % of the total acres surveyed, 81 % of all pre-project surveys conducted to date, and 83 % (211) of potential new red tree vole sites.

Recent survey data supports the concern that surveys to date have resulted in many cases of occupancy being based on nests of unknown status, which overestimates the red tree vole's abundance. Furthermore, many of the newly identified sites are in low quality habitat, and may not provide for species' persistence in the Matrix. During surveys conducted in 1997. a total of 443 individual red tree vole nests were found within 117 sites. Eighty-four (19%) of the nests were confirmed active red tree vole nests and the remaining 359 nests (18%) were either confirmed as inactive or their activity status was not determined. At 71 (61%) of the sites, no active tree vole nests were confirmed. Single active red tree vole nests were located at 14 sites (12%) and 32 sites (27%) contained one or more active nests.

This species is hard to locate, generally occurring in small clumped populations, and with a patchy distribution on the landscape (Carey 1991). Generally, when a tree vole nest is located, additional tree vole nests should be in the same stand or general area.

Habitat. Red tree voles are most frequently found in forests dominated by Douglas–fir (*Pseudotsuga menziesii*)that may also contain grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*) western hemlock (*Tsuga heterophylla*) and hardwoods. They are most numerous in late-successional and old-growth stands (Corn and Bury, 1986, Gillesberg and Carey, 1991) but may occur in younger forests (Aubrey et al. 1991; Corn and Bury 1986, 1991; Gillesburg and Carey 1991; Gomez 1993), especially if the stands contain legacy characteristics of older stand structure. Capture rates were significantly higher in old-growth Douglas-fir forests than in young (40-60 year old) or natural mature forests (Gomez 1993; Corn and Bury 1991).

Red tree voles have been documented in conifer stands from sea level to 5,500 feet in elevation. They are suspected to occur in forested stands up to 6,000 feet when stands contain some Douglas-fir trees.

Old-growth habitat appears to provide optimum conditions for red tree vole populations. The tall, multi-layered canopies of old growth retain humidity and intercept fog , which functions as a climatic buffer and a source of free water. Large branches provide stable support for nests, protection from storms, and travel routes (Gillesberg and Carey 1991). Active nests have been found in remnant older trees in younger stands indicating the importance of legacy structural characteristics. However, little is known about the minimum number or size of Douglas-fir trees, or other stand characteristics, required to sustain a local population of red tree voles. The overall effect of stand size or topographic position on maintaining vole populations is also uncertain, however, captures declined in old-growth stands less than 100 acres in size in the Cascades and Oregon Coast Range (Huff and others 1992).

Huff and others (1992) suggest a management strategy for tree vole populations that uses a rating system that includes stand area as a factor in the likelihood of a vole populations persisting in a stand over time. However, habitat models that can identify the correct combinations of moisture, topography, and stand structure to delineate primary red tree vole habitat have not been developed.

Nests. Red tree voles build nests wherever there is a suitable foundation and a readily accessible food supply. Generally, only one adult occupies each nest but multiple nests can be found in large trees. Nests are constructed of resin ducts, lichen, feces, conifer branchlets, and fine twigs (Gillesberg and Carey 1991). Single large branches, mistletoe brooms, and re-sprouted branch clusters provide stable foundations for nests in larger trees while whorls of branches provide support in young trees. The forked tops of damaged smaller trees can also provide a protected location for nests in young trees. Nests can range from 2 to 65 meters above the ground and may occur in any size tree within a stand.

SURVEY PROTOCOL

Protocol Objectives

The objective of this survey protocol is to provide a consistent approach for locating red tree vole sites in proposed project areas within the species' known or suspected range and habitat conditions within the Northwest Forest Plan area. This version of the protocol (Version 2.0) replaces the Interim Version 1.0 that was transmitted in 1996 as an attachment to U.S. Forest

Service (R6) and Bureau of Land Management (BLM) memorandum (1736-PFP BLM-OR931/1950 FS, BLM Instruction Memo No. OR-96-000 dated November 4, 1996) on interim guidance for the red tree vole.

Implementation of Protocol

The Bureau of Land Management Districts and National Forests listed in Table 1 have known red tree vole sites within their boundaries. All or part of the land area within their jurisdictions fall within the known and suspected range of the species. The California National Forests also have known sites of *A. pomo*, the southern red tree vole species which is not of concern under the NFP.

Table 1. Bureau of Land Management Districts and National Forests in Oregon and northern California within the known or suspected range of the red tree vole where surveys using the protocol should be implemented prior to ground-disturbing activities.

National Forests	Bureau of Land Management Districts
Oregon	
Mt. Hood NF	Salem District
Willamette NF	Eugene District
Siuslaw NF	Roseburg District
Umpqua NF	Coos Bay District
Rogue River NF	Medford District
Siskiyou NF	
California	
Six Rivers NF	
Klamath NF	

Trigger for Protocol Surveys

If a ground-disturbing activity (project) is located within the known or suspected geographic range of the red tree vole, and in a stand that is located at ≤ 6000 feet in elevation, the following factors should be evaluated to determine whether pre-project surveys are needed:

The activity would modify the canopy structure of the stand or the crown of one or more individual trees. Prescribed fire is considered an activity that could potentially modify the canopy and/or affect individual animals due to smoke and heat.

AND

The project is in a stand that contains Douglas-fir averaging ≥ 16" dbh and the average stand canopy closure is ≥40%.

OR

The project is in a stand that contains Douglas-fir averaging ≥ 10" and ≤16" dbh and also contains any remnant Douglas-fir ≥ 21" dbh greater than 120 years old, and the average stand canopy closure is ≥40%.

"Ground-disturbing" projects affecting red tree voles or their nests are activities that remove or modify stand canopy structure or individual tree crowns and include activities that may isolate nest trees or alter the microclimate within the stand.

Survey Methodology

Because red tree voles tend to occur in low numbers and in a somewhat clumped distribution at the landscape and stand level scales, survey techniques need to cover a large percentage of the survey area to ensure detection of red tree vole nests. Vole nest trees are an indicator of a possible vole population and are used to identify the tree vole site. The actual survey methodology used will depend upon the type of project. Either a modified line transect or individual tree examination method can be used depending on the scale and type of project under consideration.

Surveys can be conducted during all seasons of the year.

Line Transect Survey Method. This method is appropriate for surveys that encompass stand-level projects. Examples of projects best suited to this type of survey include timber harvest and prescribed fire. Unlike strip surveys, the modified line transect methods do not assume 100 percent detection but are based on a detection function approach. Studies have shown that the average detection distance of vole nests, under various stand conditions, was 15 meters on either side of the transect line.

The line transect survey method should follow these general guidelines:

- Establish the starting point of the first transect segment along the edge of the survey area and space any additional transect segments parallel to the first segment.

- Run the transects across any environmental gradients where possible.

- Using the pre-located starting point, slowly walk along a pre-determined compass bearing, or elevational contour using an altimeter, through the stand (walking along the transect center line) and visually search the entire tree canopy for likely structures on both sides of the transect.

- A minimum of 90 meters (approximately 300 feet) of transect line per acre of survey area should be searched. Assuming a transect detection width of approximately 15 meters (49 feet) on each side of the transect line, this length of survey will visually cover approximately 68 percent of an acre of survey area.

- To determine an adequate total transect length for a stand, refer to Appendix I, *"A Method for Calculating Transect Spacing for Red Tree Vole Surveys*," for guidance in performing these calculations. This length of transect should provide a good assessment of the presence or absence of voles within the stand.

- The total length of transect needed to survey a stand can be divided into varying length segments and distributed throughout the stand to accommodate stands of various shapes and sizes.

Individual Tree Examination Survey Method. This method can be used in situations where searching individual trees in a project area would be more appropriate than surveying with the line transect method (the project also needs to be evaluated in relation to the general requirements in the "Trigger for Protocol Surveys" section). Examples of projects best suited to this type of survey include snag creation, stream restoration, and single tree removal.

Individual Douglas-fir trees $\geq$ 18 inches dbh that may be modified or affected by the project should be surveyed. Trees of this diameter within at least a 100-foot radius that may be affected by felling, blasting, or other activities should also be surveyed.

General Guidelines for Both Survey Methods

- Both methods should be planned to achieve the best visibility conditions within the project area. Conditions such as rain, fog or hardwood leaves may reduce visibility in some situations.

- Transects should be walked slowly and all Douglas-fir crowns and canopy habitats searched thoroughly from several viewpoints. Take advantage of steep slope positions (even if outside the project area) to look into tree crowns.

- For the Individual Tree Examination Method, a visual search in and near the entire live crown of all trees should be conducted from several viewpoints using binoculars or a spotting scope.

When potential nest structures are observed:

- Search the nest from the ground and under the tree for possible red tree vole nest signs, particularly resin ducts (see "Identification of Nest Structures" section below). Use binoculars or spotting scopes if necessary;

- Utilize any collection or examination devices that will enable a closer view of the nest, such as extension poles (these types of devices are not discussed in this document);

- Determine the species associated with the potential nest structure(s) and the activity status of the structures (see "Identification of Nest Structures section);

- Mark all trees that are confirmed as having active red tree vole nests;

- Indicate the location as accurately as possible on a map, or using GPS

- If the nest is not confirmed, mark the tree(s) that are questionable for further evaluation or climbing at a later date, or climb the tree at that time to complete the survey.

- If a confirmed nest is located, surveys should be conducted within 330 feet (100 meters) to determine the extent of the site.

Additional Survey Guidelines

Because detection using ground surveys is difficult in stands where the dominant trees are ≥36" dbh, climbing must occur in order to ensure nests are not missed in this stand structure. If line transect or individual tree surveys do not reveal a red tree vole site, a minimum of 3 Douglas-fir trees/acre ≥36 inches dbh in the stand must be climbed. Trees selected for climbing are at the discretion of the wildlife biologist and the climber, but should be distributed throughout the stand and provide vantage points for viewing into adjacent conifer crowns.

Climbing may be the only method to verify red tree vole activity for a potential nest structure. The alternative is to assume that active nest trees are present. If trees are climbed, methods and conditions should meet agency safety standards and personnel must meet certification requirements.

Identification of Nest Structures

Red Tree Vole Nests. From the ground, red tree vole nests generally appear as dark haphazard accumulations of twigs, needles, moss, and/or lichens on the topside of a large branch or whorl of branches against the bole of a tree. Closer inspection will reveal diagnostic characteristics that will help differentiate a red tree vole nest from other arboreal rodent or bird nests. Finding or observing Douglas-fir resin ducts or seeing a red tree vole are the definitive indicators a nest has been or is occupied by a red tree vole.

There are five other arboreal rodents that build nests in trees that can be confused with the nests of the red tree vole. In addition, tree voles and other rodent species may reuse the same nest platform at different times. Therefore, you may see an old nest built by a Douglas squirrel that has an occupied red tree vole nest built on the top of the old squirrel nest.

Typical Signs Indicating a Nest Was Occupied At Some Time by a Red Tree Vole. (Confirmed Nest) Below are typical signs that may indicate a nest structure is or was used by a red tree vole, but do not confirm current activity. These characteristics may or may not be visible from the ground using binoculars or a spotting scope.

- Green Douglas-fir cuttings or branchlets piled on top of the nest structure.

- Clumps of resin ducts incorporated into the nest material. Clumps of resin ducts may be seen in the nest, sloughed off to the edge of the nest or sometimes may be found on the ground or other locations under the nest tree

- Tunnels leading into the underside of the nest.

- Evidence of hedging on branches adjacent to the nest. Foraging activity by red tree voles near very large old nests can change the growth form of small Douglas-fir branchlets due to the heavy removal of the branch tips. This clipping of the small branchlets causes the development of many new buds that sprout and give the branches a bushier look than

normal. Branches around old nests can have a sheared, rounded bushy appearance much like a hedge. This hedged look, when it occurs, can help indicate long-term use of a nest site by red tree voles. This hedged appearance occurs more in old stands and may be difficult to see from the ground by an inexperienced observer.

- Large quantities of fresh cone scales or cores piled on top of a nest may indicate usage of the nest by a squirrel. The nest may or may not have been a tree vole nest at sometime in the past.

Typical Signs of an Active Red Tree Vole Nest (Confirmed Active Nest). Diagnostic features that indicate an active red tree vole nest include most of the characteristics above but require further qualification often only available by close-up examination of the material for freshness. These features maybe visible from the ground or a sample may need to be collected and examined in hand or the tree may need to be climbed for a close-up examination of the nest. Diagnostic features must be considered as a whole when trying to determine activity status of a nest. Most of the time observers will not see the vole occupying a nest and will have to use these context clues to make determinations.

- Fresh cuttings of Douglas-fir clipped from the ends of branches, usually the current or last year's growth. These are generally 2-3 mm in diameter and 10 to 20 cm long.

- Fresh, dark green to pale green to slightly orange or light tannish resin ducts on or in the nest can indicate recent usage of the nest.

- Upon close-up examination of a nest structure in the tree, the color of the feces can sometimes be used to indicate the freshness of the fecal pellet. Bright green pellets indicate newer droppings and can indicate present or recent usage of the nest. Older fecal pellets are dark brown and become compacted into the bottom of the nest as they become wet and compressed.

Typical Signs of an Inactive Red Tree Vole Nest (Confirmed Inactive).

- Nest material is dark brown and compacted with no green resin ducts or cuttings.

- No other sign of recent activity at the nest.

- Compacted nest material is comprised primarily of a humus layer consisting of compressed feces, brown resin ducts, and small stripped twigs.

Typical Signs of Nests Built by Other Rodent Species. Nests built by the other five arboreal rodents whose ranges overlap the tree vole's tend to use slightly different and larger material. These other rodents do not create resin ducts and if resin ducts are found in a nest being used by another rodent, the resin ducts indicate a tree vole used the nest at some time. The other arboreal nests will have some of these characteristics:

- The twigs and sticks that make up the base of the nest platform can include sticks of a larger diameter and length than those added by red tree vole. For example, woodrats and the larger squirrels may include twigs up to 1 cm in diameter in the nest platform.

- The nest chambers or ball of nest material on top of platforms of sticks will be constructed of moss, shredded bark, grasses, lichens, or leaves of deciduous trees and shrubs.

Typical Signs of Very Old and Dilapidated Nests or Natural Litter Fall Accumulations. Many of the structures that surveyors detect within the forest canopy will be very old and dilapidated rodent nests or natural accumulations of litter and broken branches. From the ground, these generally appear as dark haphazard accumulations of twigs, needles, moss, and/or lichens on the topside of a large branch or whorl of branches against the tree bole just like active tree vole and squirrel nests. However many of these dilapidated nests are very compacted and do not contain any fresh material. Many will have major holes through the nest material, or the nest material will be falling off the structure. Samples of this fallen material can often be seen on the ground under the nest.

SURVEYOR SKILLS AND TRAINING

The protocol is designed for field biologists who will be analyzing red tree vole habitat and supervising red tree vole surveys on federal land within the range of the northern spotted owl. "Field biologists" are defined as those individuals currently employed as professional biologists, biological technicians, or volunteers who are supervised by a professional biologist.

Professional judgment is involved in analyzing habitat, conducting surveys, and interpreting red tree vole survey results and habitat use. Knowledge of the biology and ecology of the species and habitats will be essential for a reliable survey. The following qualifications are provided as a requirement for the personnel involved red tree vole surveys:

The minimum requirements for the supervising biologist involved in supervision and interpretation of survey results are:

- A bachelor's degree in wildlife biology or related field and/or qualification as a GS-486-9/11, and
- A thorough understanding of all aspects of this protocol.

Field surveyors should be familiar with:

- Techniques involved in project layout and establishing transect lines, and
- Identification and interpretation of visual evidence of red tree vole, including differentiation of their nests from those of other species.

It is highly recommended that potential surveyors be trained by a wildlife biologist who has received training from an expert on the species and is knowledgeable about red tree vole biology, sign, surveys, and interpretation of survey results.

DATA MANAGEMENT AND ISMS DATA ENTRY

The field and Interagency Species Management System (ISMS) database forms that should be used to record survey data are provided in Appendix II. Field units should maintain hard copies of survey plans, field forms, maps, and aerial photos used during the survey. Data sheets for each nest tree must clearly indicate the surveyor's level of confidence in the determination of vole use and activity status. Hard copies of all field data will be stored at each administrative unit and electronically entered into the ISMS database. The hard copies of field forms should be maintained by the units for a sufficient period of time to answer questions on the surveys during any regional analysis of the ISMS data.

The red tree vole survey data is collected in a nested design with three levels of data: A polygon level referred to as site data, a nest tree level or species observation data, and nest level data. The nest data is auxiliary data that will help describe the characteristics of the nests. When entering tree vole locations into the ISMS database, each nest tree should be entered as a species observation. The area delineated as the red tree vole site should be entered using the Arcview link so a polygon enclosing the site can also be digitized.

Clear records must be maintained that show which species observations occur in each red tree vole site. When entering tree vole locations there will be some cases where there is only one active tree vole nest at a site. It is important to make sure that these single nest tree sites are included in ISMS to help provide information on the species' local and regional distribution.

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FIGURE 1: Known and Suspected Range of the Oregon Red Tree Vole (*Arborimus longicaudus*)

APPENDIX I

A Sample Method for Calculating Line Transect Spacing Using the Line Transect Survey Method for Conducting Red Tree Vole Surveys

This is a sample method for calculating the approximate spacing between transects in a project.

- Draw a rectangle (or square) around the project unit large enough to enclose the area that will be ground-disturbing for red tree voles (i.e. the survey area) with one side of the figure parallel to the desired direction the transects will run.

- Measure each side of the rectangle and calculate its area in square feet.

- Divide the resulting area by 43,560 feet to equal the total acres of the rectangle.

- Divide these acres by 300 feet to get the minimum number of transect footage needed for the rectangle.

- Divide the total transect footage by the length of the side of the rectangle which is parallel to the direction the transects will run. This will indicate the approximate number of transect lines needed for the project area.

- Divide the length of the other side of the rectangle (perpendicular to the direction the transect lines will run) by the number of transect lines calculated in step 5 to arrive at the approximate spacing between transect lines.

- Lay out the transect lines on a project map and measure the total linear feet of transect lines within the area to be surveyed to ensure at least 300 feet of transect line per acre of survey area will be surveyed. It may be necessary to adjust the number of transect lines after this step.

APPENDIX II

Field and ISMS Data Forms